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Safe Motherhood Studies—Results from Benin

Competency of Skilled Birth Attendants

The Enabling Environment for Skilled Attendance at Delivery

In-Hospital Delays in Obstetric Care (Documenting the Third Delay)

Sourou Gbangbade, Steven A. Harvey, Wendy Edson,
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November 2003

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Abstract

Each year, more than 500,000 women worldwide die from complications related to childbirth. With good quality obstetric care, approximately 90 percent of these deaths could be averted. The assistance of a skilled birth attendant during labor, delivery and the immediate postpartum period is one important component of quality obstetric care. An enabling environment for skilled attendance at delivery and prompt attention for women arriving at a medical facility with an obstetric complication are also key factors. However, little is known about the competence of skilled birth attendants, the elements that contribute to an enabling environment and the causes of what is commonly known as the "third delay:" the delay in receiving medical attention after a woman arrives at a healthcare facility.

Through its Safe Motherhood Research Program, the Quality Assurance Project carried out three studies to explore these issues in countries with high maternal mortality ratios. The first study examined the competency of skilled birth attendants (SBAs). The second measured SBA performance and the relative contribution to performance of different enabling factors in the work environment. The last study examined causes of in-facility delays in receiving obstetric care. All three studies were carried out between September 2001 and July 2002 in Benin, Ecuador, Jamaica, and Rwanda. This report presents the results from Benin. The Benin studies included five hospitals: a tertiary care referral hospital with an active maternity department, two secondary care hospitals, and two smaller district hospitals.

The competency study measured knowledge with a 72-question test covering six subject areas. We also tested skills in several key areas including ability to use a partograph, neonatal resuscitation, manual removal of placenta, bimanual uterine compression and IV insertion. Finally, we asked participants to assess their own ability to carry out common obstetric procedures. Results show that current competency levels are low. Two key skills, bimanual uterine compression and active management of third stage labor, are rarely taught and rarely practiced. We found little difference in competency by professional level. Physicians do somewhat better with complex procedures, but professional level appears inversely related to the interpersonal quality of care. There was no correlation between providers' self-assessment and their competency as measured by the knowledge and skills tests.

The enabling environment study addressed the contribution of enabling factors and essential elements to health worker performance. We used an observation checklist to evaluate performance during labor, delivery and the immediate postpartum period. We reviewed medical records to evaluate performance at managing obstetric complications. We also surveyed providers in each facility about supervision, training and motivation. Finally, we inventoried the availability of essential drugs, equipment and supplies in each study hospital. Although most staff had extensive professional training, less than half said they had received any training in the last two years. Labor monitoring, including checking fetal heart rate and mother's blood pressure, was inadequate in most observed cases. Providers used a partograph only about two-thirds of the time. Few washed their hands before assisting at delivery and none suctioned the newborn after birth, but most administered oxytocin to the mother after delivery.

The third delay study used direct observation to analyze patient flow in three of the five study hospitals. In addition, two physicians reviewed medical records to determine if there were delays at different points in the care of the patient. Most of the delays found in the record review occurred during diagnosis, especially for obstructed labor and severe pre-eclampsia/eclampsia. Waiting times after arrival at the hospital or the OB department varied by hospital but were unusually long at the regional referral hospital (RRH), one of the two secondary level facilities included in the study. We recommend a quality improvement initiative to improve medical records at all hospitals. For RRHs, we also recommend developing a systematic triage system to reduce waiting times for incoming patients.

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Introduction

A. Background

Each year more than 500,000 women worldwide die from complications related to childbirth.[1; 2] Maternal experts agree that skilled attendance "during labor, delivery and in the early postpartum period" is perhaps the most important key to reducing maternal mortality.[3-6] In fact, the percentage of births assisted by a skilled attendant has become a proxy indicator for progress in reducing maternal mortality.[7]

However, consensus is lacking on how to define "skilled attendant." Absent such a definition, many rely on Demographic and Health Survey (DHS) data reporting the percentage of deliveries assisted by "health personnel," typically doctors, nurses, and nurse midwives. Though the DHS program does not attempt to assess the knowledge or skills of the attendants it categorizes as "health personnel," others who extrapolate from DHS data use the terms "health personnel" and "skilled birth attendant" (SBA) interchangeably.[8] Unfortunately, we have limited information about the competence of SBAs at managing labor, delivery, and the immediate postpartum period. We also know little about their competence at managing the most common life-threatening complications of childbirth: hemorrhage, pregnancy-induced hypertension, sepsis, obstructed labor, and post-abortion complications.[9]

Competent attendance can make an important contribution towards improving birth outcomes and reducing maternal morbidity and mortality. But even a highly competent attendant needs an enabling environment to perform optimally. The elements of an enabling environment include such things as availability of essential drugs and equipment, leadership, supervision, job aids, policies, guidelines, and even the process used to develop and adopt standards. Also critical is the way services are organized to facilitate or impede the delivery of care. We know little about the presence or absence of specific

Abbreviations

C-section	Cesarean section
CEOC	Comprehensive essential obstetric care
CI	Confidence interval
CPD	Cephalo-pelvic disproportion
CRH	Church referral hospital
DHS	Demographic and Health Survey
DH1	District hospital in Ouidah, Benin
DH2	District hospital in Pobe, Benin
ER	Emergency room
FHR	Fetal heart rate
HW	Health worker
IMPAC	Integrated Management of Pregnancy and Childbirth
IV	Intravenous
MMR	Maternal mortality ratio
NRH	National tertiary hospital
NS	Not significant
OB	Obstetric
Ob/Gyn	Obstetrician/gynecologist
OSCE	Objective structured clinical evaluations
PIH	Pregnancy-induced hypertension
PROSAF	Benin Integrated Family Health Program
QAP	Quality Assurance Project
RRH	Regional referral hospital
SBA	Skilled birth attendant
SD	Standard deviation
STI	Sexually transmitted infection
USAID	U.S. Agency for International Development
WHO	World Health Organization

environmental factors in high maternal mortality settings. Similarly, we know little about the relative contribution of these different factors to performance outcomes.

A key contributor to maternal death when an obstetric complication occurs is the delay in receiving care once a woman arrives at a health facility. This is the third delay in what has become widely known as the "three delays model" of maternal mortality.[10] Many factors contribute to this third delay: lack of personnel, supplies, and equipment; delay in reaching a diagnosis; inability of the patient or her family to pay for care, drugs or supplies; and the time of day or day of the week when the patient arrives, among others.[11-17] While studies have examined different aspects of the third delay in different settings, there is a need to define this delay more clearly for the five major causes of maternal mortality mentioned above. There is also a need to specify acceptable time intervals between a woman's arrival at a facility with a particular obstetric complication and the start of treatment for that complication. Finally, different studies have attempted to measure time intervals between arrival and treatment by several different methods, but it is not clear which of these are most reliable and practical in high maternal mortality settings.

To address the issues discussed above, the Quality Assurance Project (QAP) carried out a Safe Motherhood Research Program, which consisted of three studies in countries with high maternal mortality ratios. The first study examined the competency of birth attendants, the second measured performance and gauged the relative contribution of different enabling factors within the work environment, and the last study examined the third delay. This Safe Motherhood Research Program was carried out between September 2001 and July 2002 in Benin, Ecuador, Jamaica, and Rwanda. This report presents the results from Benin.

According to WHO estimates, the maternal mortality ratio (MMR) for Benin was 884 deaths for every 100,000 live births in 1995.[1] This compares to 1,006 per 100,000 for Africa as a whole. An estimated 65.5 percent of deliveries in Benin are attended by trained health personnel.[18] About 63.9 percent occur in health facilities.[19] Midwives (*sage-femme*) attend most institutional deliveries. Doctors or medical residents supervise midwives and sometimes assist in the case of complications but rarely serve as primary birth attendants.

B. Research Design

We carried out pilot tests of all study instruments in Ecuador during November and December of 2001. Health facilities participating in the pilot tests included one provincial level hospital, and one church hospital in Quito and one county-level hospital on the outskirts of Quito. After the pilot test, instruments were modified, translated into French and then extensively reviewed and revised with the study team in Cotonou. Study hospitals were selected purposively according to the following criteria:

1. A range of levels of care including:
   - One tertiary care referral hospital with an active maternity department that manages a large number of maternal complications.
   - Two mid-sized (secondary care) hospitals.
   - Two smaller district hospitals.
2. An average of at least two births per day, sufficient to permit observation of at least five cases over a two-three day period.
3. At least some facilities outside the capital city but geographically close enough to be manageable within the time and budget available.

Based on the criteria proposed by Maine et al., all five hospitals selected for the study qualified as Comprehensive Essential Obstetric Care (CEOC) facilities.[20] Table 1 presents the sample characteristics for each study. A description of the data collection methods used for each study follows. All data collection instruments are included in Appendix A. The names, professional qualifications and specific data collection activities of all study personnel appear in Appendix B.

Table 1. Sample characteristics for maternal health studies

Hospital Type: Location	Competency Study			Enabling Environment Study			Third Delay Study	
	Knowledge Surveys	OB Skills Stations	Provider Self-Evaluations	Births Observed	Essential Elements Checklists Completed	Enabling Factors Surveys Completed	Medical Records Audited	OB Ward Patient Flow*
National tertiary referral hospital Cotonou (NRH)	24	23	22	11	2	23	21	12
Non-profit (church) referral hospital Cotonou (CRH)	3	3	3	7	2	3	17	5
Regional referral hospital Porto Novo (RRH)	9	9	9	10	1	9	25	12
District hospital Ouidah (DH1)	4	4	4	7	2	4	10	-
District hospital Pobe (DH2)	3	3	3	6	2	3	-	-
Total	**43**	**42**	**41**	**41**	**9**	**42**	**73**	**29**

* Combined patient flow in the emergency room and the obstetric ward, which are generally adjacent facilities in Beninese hospitals.

Competency Study

A. Objectives

Objectives for the Competency Study were to develop, test, and apply instruments to measure the competency of health personnel who attend women during labor, delivery, and in the immediate postpartum period. More specifically, our objective was to develop assessment methods that would both be valid measures of key competencies and practical for program managers. By being practical for program managers, we mean:

- Simple to apply and evaluate locally without assembling a large study team or hiring outside consultants.
- Rapid testing (applicable in 1 day or less) so as not to remove essential health personnel from their duties for a long period of time.
- Based on technology affordable and applicable in low-resource settings such as Ministry of Health facilities with no budget or personnel dedicated specifically to research and evaluation.

B. Methods

Following quality improvement literature, we defined competence as the possession of knowledge and skills sufficient to comply with predefined clinical standards.[21] Since cross country comparisons were a key goal of the study, we used the WHO's IMPAC guidelines as a benchmark for our measurements.[22] Where Beninese national standards differed from IMPAC guidelines, we tested providers on both. To measure knowledge, we developed a 72-question multiple-choice and fill-in-the blank test with six topic areas: aseptic procedure, labor and delivery, immediate newborn care, and management of hemorrhage, pregnancy-induced hypertension (pre-eclampsia and eclampsia) and sepsis. Questions were adapted from training evaluation instruments developed by MotherCare and the Maternal and Neonatal Health Project.[23-25] Additional sources of information included IMPAC guidelines, Benin Ministry of Public Health guidelines, the list of basic SBA competencies developed by the Safe Motherhood Interagency Group, and consultation with experts both internationally and in Benin.[26; 4; 22]

To measure skills, we adapted five instruments developed by the Maternal and Neonatal Health Program: (1) ability to use a partograph as a decision-making tool in labor and delivery, (2) neonatal resuscitation with an ambu bag, (3) neonatal resuscitation mouth-to-mouth and nose, (4) manual removal of placenta,

and (5) bimanual uterine compression.[25] A similar approach was used by MotherCare in Indonesia.[23] We also developed a checklist for measuring skill at IV insertion, a critical aspect of managing pre-eclampsia and eclampsia as well as most other complications of pregnancy and childbirth.

The knowledge test and the partograph exercise were administered in written form and required approximately four hours to complete. During the partograph exercise, participants were presented with data from two different cases, one of prolonged labor, the second of acute fetal distress. Participants were asked to plot the data on a partograph and to answer questions about how they would manage each case using the data and the plots. Participants then rotated through five skills stations modeled on Objective Structured Clinical Evaluations (OSCE) similar to those described by McDermott.[23] At one station, a pediatrician evaluated participants' skills at neonatal resuscitation, first mouth-to-mouth and nose, then with an ambu bag. At a second station, an Ob/Gyn evaluated participants' skills at manual removal of placenta and bimanual uterine compression. At the third station, an MD anesthesiologist evaluated participants on their IV insertion skills. Participants performed all procedures on anatomical models and were evaluated with a structured observation checklist. Evaluators instructed each participant to prepare for the procedure, carry it out, and then complete post-procedure tasks exactly as if they were treating a real patient. A total of three rounds of testing occurred on three different days: round one for providers from the hospitals in Cotonou, round two for those from RRH and DH2, and round three for providers from DH1.

Finally, we asked participants to evaluate their own abilities in seven key areas: (1) infection prevention and equipment sterilization, (2) use of a partograph, (3) active management of third-stage labor, (4) manual removal of placenta, (5) bimanual uterine compression, (6) neonatal resuscitation, and (7) IV insertion. Participants ranked the difficulty of each task on a four-point scale: very easy, easy, a little bit difficult, and very difficult. Other options included "I never do this skill/procedure" or "don't know/not applicable." Participants completed this self-evaluation survey at the same time as the knowledge test and the partograph exercise.

To permit comparison between competency and performance (measured as part of the Enabling Environment study), providers at each study facility were first observed attending one or more actual deliveries.

C. Results

A total of 43 providers from the five different hospitals completed the knowledge test. Providers tested included one attending physician, four medical residents and 38 nurse-midwives. Most participants completed the written test in about 90 minutes, but a few took up to 2 ½ hours.

The mean overall score for the knowledge test was 50 percent (95 percent CI 47.3–52.7, SD 8.7 percent). Table 2 presents mean scores for the test as a whole and for each of the six topic areas. All scores are reported as the percent of questions answered correctly. Since the overwhelming majority of providers (38/43) tested in Benin were midwives, it was not possible to test for differences in score by each type of provider. However, some differences in score became apparent when providers were re-categorized into doctors (n=5 including the attending physician and the four medical residents) versus midwives. Doctors scored 10.7 percent higher overall on the knowledge test (p=0.008) and 14.6 percent higher on questions related to labor and delivery (p=0.01). Interestingly, doctors scored only marginally better than midwives on questions related to postpartum hemorrhage (11.3 percent, p=0.07) and pregnancy-induced hypertension (13.5 percent, p=0.08) and no better than midwives on questions related to management of sepsis, third stage labor or immediate newborn care.

There were few differences in score between providers from different hospitals. On questions related to asepsia, providers from the national referral hospital (NRH) scored 37 percent higher than providers from the regional referral hospital (RRH, p=0.001). On questions related to labor and delivery, providers from NRH scored 19.5 percent higher than providers from the district hospital in Pobe (DH2) and 16.5 percent higher than

providers from the church referral hospital (CRH). Neither difference was statistically significant, perhaps because only three providers were tested in each of the two smaller hospitals. The mean test score was slightly higher for providers from the national referral hospital than providers from all other hospitals combined (52.4 percent versus 47.0 percent, p=0.04). The mean score on questions related to asepsia were also higher (70.8 percent vs. 47.4 percent p=0.003). However there were no differences on questions related to managing obstetric complications. Since the test included only two questions related to active management of third stage labor, it is not meaningful to calculate a mean or standard deviation for responses on this topic. However, 34 out of the 43 participants answered both questions incorrectly while 9 answered one question correctly. No one answered both questions correctly. There were no significant differences in score between providers from different hospitals or by professional training (doctor vs. midwife).

Table 2. Knowledge test scores (n=43)

Theme	# Questions	Mean	95% CI	SD
Total score	72	50.0%	47.3-52.7%	8.7%
Asepsia/antisepsia	7	60.5%	52.3-68.7%	26.7%
Labor & delivery	24	48.0%	44.2-51.8%	12.2%
Immediate newborn care	11	49.1%	42.4-55.7%	21.7%
Postpartum hemorrhage	13	51.5%	47.4-55.6%	13.3%
Pregnancy-induced hypertension*	9	54.8%	49.8-59.8%	16.3%
Sepsis	6	38.0%	32.8-43.2%	16.8%
Active management 3rd stage labor	2	N/A	N/A	N/A

* The test included 11 questions on PIH. Two were dropped from analysis because no participants answered them correctly and these answers were not correlated with responses to other PIH-related questions.

One midwife at the national referral hospital left the study after finishing the knowledge test, so a total of 42 providers completed the partograph case studies. The mean overall score for the two cases combined was 66.7 percent (95 percent CI 59.8-73.5 percent, SD 21.8 percent). On average, participants scored significantly higher on the first case study (71.1 percent) than on the second (57.5 percent, t=3.65, p=0.001). There was no difference in score between written questions and questions requiring that information be plotted on the partograph. Given the small number of providers participating from each hospital, it was not possible to test for differences in scores between hospitals. There was no difference in scores between providers from the referral hospital and providers from all other hospitals combined. Doctors scored significantly higher than midwives overall (90.0 percent vs. 63.5 percent, p<0.001) and on both of the cases individually (90.9 percent vs. 68.4 percent, p=0.02 and 88.2 percent vs. 53.3 percent, p<0.001 respectively).

The same 42 providers completed the skills stations as had completed the partograph case studies. Because of the large number of providers tested at the national referral hospital on a single day, rotating all participants through all five skills exercises took 6½ hours, at least 2½ hours longer than anticipated. There were significant bottlenecks especially at the obstetric skills station where each participant had to demonstrate both manual removal of the placenta and bimanual uterine compression on a single anatomical model. As a result, some participants waited an hour or more between stations. This was not a problem at the hospitals outside Cotonou since the numbers of providers tested on any one day were much smaller.

As noted above, each skill station was organized into three parts: preparing for the procedure, carrying out the procedure, and completing post-procedure tasks. In the preparatory and post-procedure portions of each station, participants were evaluated on their compliance with standards for aseptic procedure (e.g., washing hands, using new or re-sterilized gloves, disinfecting equipment, disposing of or disinfecting gloves properly). Also included in preparatory and post-procedure evaluation was something we came to

call "patient rapport:" did the provider greet the patient, explain what he or she was going to do, provide emotional support, and explain the outcome afterwards, etc.? Before examining scores for each skill individually, we tested for significant differences in mean score between the preparatory and post-procedure tasks versus tasks associated with the procedure itself. Since the evaluations were carried out with anatomical models rather than real patients, we hypothesized that providers might pay more attention to the procedure itself than to asepsia and patient rapport. If this were the case, we expected higher scores on the middle part of each skill station than on the first and third part.

T-tests showed significantly higher scores on the procedure part of the test for neonatal resuscitation with an ambu bag ($p=0.002$), neonatal resuscitation mouth-to-mouth and nose ($p<0.001$), manual removal of placenta ($p<0.001$), and bimanual uterine compression ($p=0.03$). As a result, we based the analysis on the total score (pre- + procedure + post-) for the IV insertion station, but on the procedure score alone for the two neonatal resuscitation stations and the two obstetric skills stations. We also created an overall competency index for asepsia and for patient rapport by summing the questions from each station related to these topics. Mean scores overall, scores for each station and scores for asepsia and patient rapport are displayed in Table 3.

Table 3. Skills station scores (n=42)

Skill Station/Index	Mean	95% CI	SD
Overall skill	54.4%	51.6-57.2%	9.0%
Resuscitation with ambu bag*	61.4%	55.8-67.1%	18.1%
Resuscitation mouth-to-mouth & nose*	68.2%	62.0-74.3%	19.7%
Manual removal of placenta*	78.6%	75.9-81.2%	8.5%
Bimanual uterine compression*	11.2%	1.6-20.9%	31.0%
IV insertion	79.4%	76.6-82.2%	1.4%
Asepsia	55.2%	52.5-58.0%	1.4%
Patient rapport	18.4%	14.8-21.9%	1.8%

* Procedure scores rather than total scores are reported for these stations.

Doctors in our sample scored higher than midwives in correctly performing neonatal resuscitation both with an ambu bag ($t=2.84$, $p=0.007$) and mouth-to-mouth and nose ($t=3.71$, $p=0.002$). Midwives scored marginally better on patient rapport ($t=1.8$, $p=0.08$) and marginally worse at manual removal of placenta ($t=-1.86$, $p=0.07$). There was no difference in scores between doctors and midwives on skills at carrying out manual removal of placenta, inserting an IV line, or maintaining aseptic procedure. There was also no difference between doctors and midwives in overall skills' score.

Providers from the national referral hospital scored better than providers from the other four hospitals combined on overall skills ($p<0.001$) and on all individual skills tested except for patient rapport, manual removal of placenta, and IV insertion. Additional differences became apparent when the hospitals were re-categorized as national level referral (NRH), regional and church level referral (RRH and CRH) and district level (DH1 and DH2). These differences are displayed in Appendix C, Table C-1.

A total of 41 participants completed the self-evaluation exercise. The majority of respondents reported that six of the seven tasks were "easy" or "very easy" to carry out, though in some cases a significant percentage of respondents said that they rarely or never carried out the task. Only in the case of bimanual uterine compression were responses split nearly evenly between "easy or very easy," "difficult or very difficult" and "I don't perform this task." As measured by the knowledge and skills evaluations, there was no correlation between an individual provider's self-assessment and his or her ability to correctly perform a procedure or answer questions about it.

D. Discussion

1. Logistics

The knowledge test in its current version was quite long, particularly given that participants were asked to complete the partograph case studies and respond to questions on their work environment at the same time. All told, these written exercises took about 4 hours to complete. The amount of time necessary to complete the skills stations depends on both the number of participants and the number of anatomical models and observers available. Each station requires a minimum of 20 minutes per participant. The two obstetric stations require about 30 minutes per participant since the tasks involved are more numerous and more complex. Unless the timing of the exercise is carefully scheduled and the flow of participants through the skills stations carefully managed, participants can face long waits from the time they finish one skill station until the time another becomes available. This caused difficulties for providers who had come to the testing directly after finishing a night shift as well as for those who were scheduled to begin an evening shift shortly after the evaluation ended.

One way to avoid these would be to increase the number of anatomical models and observers: with two pelvic models and two neonate models it is possible to test five participants simultaneously. A second IV arm would also be useful, since this station takes less time to complete than the other four. However, buying additional models and hiring additional observers would significantly increase the cost of the evaluation. Another option would be to test fewer providers on any given day. This would reduce bottlenecks that form between skills stations and eliminate the need to purchase additional models and hire additional observers. However it would require paying observers for a longer period of time. More importantly, it would open the possibility that providers who have completed the evaluation would share information with and provide coaching to their colleagues. This issue was noted by McDermott, et al. during their work in Indonesia and was one of the reasons we elected to test all participating providers from a given facility at the same time.[23] The most viable solution might be to reduce the number of questions on the knowledge test and to schedule the knowledge test and the skills stations over two simultaneous sessions. With this approach, half the participants would complete the written exercises in the morning while the other half worked their way through the skills stations. Then each group would switch places in the afternoon.

2. Competency scores

Several issues stand out in reviewing the knowledge and skills scores. First, while doctors scored higher than midwives on knowledge questions and skills related to normal labor and delivery and aseptic procedure, there were no differences on knowledge questions and skills related to obstetric complications. Given that our sample contained only five doctors, it is difficult to know if this pattern is representative of the difference between doctors and midwives generally in Benin. If so, it suggests that a women experiencing a life-threatening complication may be no better off under the care of a doctor than under the care of a midwife, a cause for significant concern since it is precisely in the case of a complication that a doctor's purportedly greater knowledge and skill should be able to save a life that might be lost if managed by a health worker with less training and experience.

In a similar vein, scores of the participants from the national tertiary care hospital (NRH) were no higher than those of participants from lower level hospitals in the case of the knowledge test and partograph case studies. Skills scores at NRH were higher for both types of neonatal resuscitation and for bimanual uterine compression, but no different for manual removal of placenta and IV insertion. This seems to suggest that a woman referred to NRH from a lower-level facility might receive better care in some cases but not in others.

Second, midwives' low scores on the partograph case studies should also be cause for concern. The partograph is intended as a simple tool that can provide early warning of and guide opportune response to

complications during labor. Appropriate use of the partograph should help a first-line birth attendant such as a midwife know when she needs to intervene or—even more important—seek help from a higher level health professional or transfer the patient to a higher level health facility. That midwives in our sample scored only 68.4 percent and 53.3 percent on the two partograph case studies, respectively, suggests that they are not able to make optimum use of the partograph to recognize and manage complications in an opportune manner.

The international Safe Motherhood movement considers bimanual uterine compression and active management of 3rd stage labor to be key life-saving skills in cases of postpartum hemorrhage.[27] On average, our participants performed correctly only about 11 percent of the steps needed to complete a bimanual uterine compression. Only 9 out of 43 participants answered at least one question on third stage management correctly; no one answered both questions correctly. These very low scores suggest that these two relatively basic interventions are unlikely to be performed in Benin.

The lack of correlation between knowledge and skills scores for the different topics tested in this evaluation may confirm that knowledge and skills are two distinct dimensions of competence: knowing intellectually how a procedure works or what it is supposed to accomplish does not necessarily indicate ability to perform it and vice versa. To get a valid measure of competence, it is necessary to test both knowledge and skills.

Some researchers suggest that provider self-assessment may be a reasonably accurate reflection of competence.[28] Our experience suggests otherwise. Given the complete lack of correlation between provider self-assessment and scores on related sections of the knowledge and skills tests in this evaluation, we would strongly advise against relying upon an SBA's self-assessment as a measure of their knowledge about or ability to perform a given task.

Enabling Environment Study

A. Objectives

The objective for the Enabling Environment Study was to better understand the relative contribution of core enabling factors and essential elements to the performance of health personnel who attend women during labor, delivery, and in the immediate postpartum period. To the extent possible, we also hoped to assess the relative contribution of competency to performance in the context of environments with different enabling factors and essential elements.

B. Methods

Examining how different environmental factors influence performance requires measuring performance itself (as an outcome variable) and the factors thought to contribute to it (as explanatory variables). As one performance measure, we used a structured observation checklist based on IMPAC guidelines to observe management of labor, delivery and the first two hours of postpartum care for both mother and newborn. As shown in Table 1, we observed 6-11 cases in each of the five study hospitals. Within each study facility, these observations were scheduled to include both weekday and weekend hours as well as morning, afternoon/evening, and night shifts. Shift rotations previously scheduled by each facility determined which providers would be observed on which days and during which shifts. Six members of the study team participated in observing performance: three Ob/Gyns, two pediatricians and one midwife (*sage-femme*). Each case was observed by either one or two of the six observers.

We conducted medical record reviews to evaluate performance at managing three obstetric complications: hemorrhage, pre-eclampsia or eclampsia and sepsis. We opted for record reviews because, given the time available for data collection, it was unlikely that we would be able to observe a sufficient number of complications as they occurred. Record reviews were carried out using the same medical histories

reviewed for the Third Delay study. A more complete description of the review process appears under the methods section for Third Delay. One Ob/Gyn and the physician/anesthesiologist carried out all record reviews for both studies. They evaluated performance by determining whether the team managing each patient had carried out a set of 4-10 very basic steps indicated by IMPAC guidelines as essential for each complication. As with the Third Delay record review, performance at managing obstetric complications was evaluated at four of the five study hospitals.

Data on factors that contribute to an enabling environment were collected with four different instruments. One (form B.2.5) assessed the presence of ***essential elements*** in the obstetrics ward (*salle d'acouchement*), the emergency service (*salle d'urgence*) and the hospital's retail pharmacy (*pharmacie de detail*) in each hospital where these services existed. We defined essential elements of care as availability of such things as key drugs, equipment and supplies, 24-hour service and written standards. The list of essential elements was created based on the WHO Safe Motherhood Assessment package, input from Beninese Ob/Gyns and published literature.[4; 29; 30] Five different members of the study team collected the data on essential elements. The other three instruments were completed by providers at the same time as they completed the written portion of the competency test. Providers were first asked to list all factors that contributed in either a positive or a negative way to their performance as birth attendants (form B.2.1). This was administered in the form of a free-list according to the technique described by Weller and Romney.[31] Once they had completed the free-list, each provider was asked to respond to a 31-question survey examining different aspects of motivation (form B.2.2). Questions for this survey were adapted from previous research on health worker motivation in developing countries.[31-34] Finally each provider completed a written survey about the presence or absence of certain ***enabling factors*** in their work environment such as adequate training, supervision, team work, and use of job aids among others (form B.2.3).

C. Results

1. Health Worker Motivation and Enabling Factors–Health Worker Level Data

Motivation Survey

The scores for the two parts of the Motivation Survey indicate moderate levels of satisfaction, on average. The 19 items in the Satisfaction I scale focus on the health worker's job satisfaction. The 12 items in the Satisfaction II scale focus on the health worker's hospital environment. Each item is a 5-point Likert scale where 1 = very unsatisfied and 5 = very satisfied. The two scales do not correlate highly (Pearson r =.147, n=41). However, Cronbach's alphas for the scales indicate that they are internally consistent (Satisfaction I, α = .761 Satisfaction II, α = .755). Average scores for the two scales were computed by taking the mean of items in the scale, while allowing up to 25 percent of the items in the scale to be missing in the calculation of the index score for each individual.

Satisfaction I – Health Worker's Job (Items 1-19)

Mean (SD) = 3.2 (0.5), Range = 2.1 to 4.2, N=41.

Satisfaction II – Health Worker's Hospital Environment (Items 20-31)

Mean (SD) = 3.6 (0.5), Range =2.0 to 4.6, N=42.

Analysis of variance of the Satisfaction scores by hospital indicates no statistically significant differences. Average scores of Satisfaction I range from 3.00 (RRH) to 3.61 (DH1). Average scores on Satisfaction II range from 3.38 (DH1) to 3.89 (DH2).

Enabling Factors

Training in Past 2 Years: A count of training in the past two years was calculated by summing training indicated on the following items: EOC training (item 4), interpersonal communication training (item 7) and other training on labor and delivery (item 8). Items were coded 0 for 'no training' and 1 or higher for 'any training,' or in the case of EOC training, to indicate the number of trainings in the past 2 years.

Mean (SD) = 1.83 (1.5), Range = 0 to 5, N=42.

HW's Assessment of Proper Use of Clinical Histories: A measure indicating the proper use of clinical histories was calculated by averaging three items on different aspects of clinical histories (items 11.1, 11.2, 11.3). Each item is scored on a 5-point scale ranging from 1 'never' to 5 'always' indicating the proper use and completion of clinical histories.

Mean (SD) = 3.7 (0.7), Range = 1 to 5, N=42.

HW's Assessment of Performance of Self and Others: A summary measure of the health worker's subjective assessment of different aspects of their performance and the performance of co-workers was calculated by averaging the following items: 13, 14, 15, 16, 17, 18, 19, 20. Up to 25 percent of the items were allowed to be missing in the calculation of the score for that individual. Items were reverse coded as needed (items 15, 17, 18, and 19). The response scale ranges from 1, 'strongly disagree' to 5 'strongly agree.'

Mean (SD) = 3.61 (0.3), Range = 2.75 to 4.38, N=42.

HW's Assessment of Presence of Supervisory System: A count of the presence of internal and/or external supervisory systems was calculated by summing items 21 and 26 (coded 0 for 'no supervisory system,' and 1 for 'supervisory system').

Mean (SD) = 1.10 (0.6), Range = 1 to 2, N=41.

Motivation and Enabling Factors by Hospital

Table 4 presents the means of the two satisfaction factors and four enabling factors for the five hospitals. Because the sample sizes are very small, these figures are not reliable estimates.

Table 4. Motivating and enabling factors: Average score by hospital

Hospital	Job Satisfaction (1–5)	Satisfaction with Hospital Environment (1–5)	Mean Number of Trainings in Past 2 Years	HW's Assessment: Presence of Supervisory System (0–2)	HW's Assessment: Proper Use of Clinical Histories (1–5)	HW's Assessment: Performance of Self and Others (1–5)
NRH (n=23)	3.18	3.62	1.56	1.09	3.77	3.63
CRH (n=3)	3.20	3.67	1.29	1.25	3.92	3.50
RRH (n=9)	3.00	3.61	1.04	0.88	3.75	3.73
DH1 (n=4)	3.61	3.38	1.00	0.75	3.83	3.38
DH2 (n=3)	3.11	3.89	1.00	2.00	2.78	3.52

Associations between Health Worker Motivation and Enabling Factors

No significant associations were found among job satisfaction, satisfaction with hospital environment, training, presence of supervisory system, use of clinical histories, and perceived performance.

2. Observed Performance during Labor, Delivery, and Postpartum

Characteristics of Birthing Mothers

Observations of 41 birthing mothers were made at all five different hospitals. Characteristics of birthing mothers are summarized in Tables 5a and b.

Table 5a. Characteristics of birthing mothers

	Mean	SD	Min	Max	N
Average age in years	25.5	4.4	17.0	35.0	37.0
Previous births (average)	1.5	1.6	0.0	5.0	40.0

Table 5b. Characteristics of birthing mothers

	N	%
First Language		
French	3	7.3
Fon	16	39.0
Other	20	48.8
Missing	2	4.9
Ethnicity		
Fon/Goun	20	48.8
Nagot/Yoruba	8	19.5
Other	12	29.3
Missing	1	2.4
Accompanied by Anyone		
Yes	36	87.8
No	4	9.8
Missing	1	2.4
Diagnosis		
Tuberculosis	0	0
HIV/AIDS	1	2.4
Syphilis	8	19.5
Other STI	0	0

Health Worker Team Characteristics

Composition of the health worker team was divided into three main categories: (1) attending physician, medical resident, intern, (2) nurse, midwife (3) auxiliary nurse/aide, other. The third category (auxiliary nurse/aide, other) is referred to as "other health worker" in the analysis summary below. The skill level, size and composition of the teams are discussed below and results summarized by phase and hospital in Tables 6 and 7.

Labor:

Number of Health Workers: During labor, the health worker team on average consisted of 2.3 workers (SD=1.3, Range = 1 to 6, N=41). A slight majority of cases (51.2 percent) were attended by one worker during labor.

Team Composition: During labor 68.3 percent of the births were attended by one or more nurses, and one other health worker.

Intrapartum Phase:

Number of Health Workers: During the intrapartum phase, the health worker team on average consisted of 1.2 workers (SD=0.5, Range = 1 to 3, N=37). The majority of cases (83.8 percent) received care from one health worker during the intrapartum phase.

Team Composition: In 29 (78.4 percent) of the 37 cases with non-missing data, a single nurse/midwife attended the mother during the intrapartum phase. A physician/resident/intern was present during the intrapartum phase in 4 (10.8 percent) of the 37 cases observed.

Postpartum-Mother:

Number of Health Workers: During postpartum care, the health worker team attending to the mother on average consisted of 1.7 workers (SD=0.8, Range = 1 to 4, N=35).

Team Composition: During postpartum care of the mother, a midwife/nurse was present most often (82.9 percent, or 29 of the 35 cases with non-missing data), usually with one other health worker. A physician was present in two of the cases.

Postpartum-Neonate:

Number of Health Workers: During postpartum care, the health worker team attending to the neonate on average consisted of 1.4 workers (SD=0.9, Range = 1 to 5, N=34). The majority of cases (73.5 percent) received care from one health worker.

Team Composition: During postpartum care of the infant, the majority of neonates received care from another health worker (79.4 percent). None of the neonates received care from a physician during the postpartum phase.

In addition to the team characteristics above, teams were divided into two groups: (1) teams with skilled workers (MD, Resident, Nurse, Midwife, Intern) and (2) teams with less skilled workers only ("Other" or Auxiliary Health Worker). Table 6 shows the percentage of skilled and unskilled teams by phase. Table 7 summarizes the average size of teams by phase and hospital.

Table 6. Skilled versus less skilled teams

Phase	Skilled Team	Less Skilled Team
	N (%)	N (%)
Labor	39 (95.1)	2 (4.9)
Intrapartum	37 (100.0)	0 (0.0)
Postpartum mother	31 (88.6)	4 (11.4)
Postpartum newborn	7 (20.6)	27 (79.4)

Table 7. Size of teams in attendance during labor, intrapartum, and postpartum, by hospital

Phase	Average Number of Providers Present during Phase				
	NRH (n=11)	CRH (n=7)	RRH (n=10)	DH1 (n=7)	DH2 (n=6)
Labor	3.00	2.14	2.00	2.86	1.50
Intrapartum	1.22	1.14	1.13	1.29	1.67
Postpartum mother	1.63	2.29	1.43	1.71	1.50
Postpartum newborn	1.00	2.43	1.00	1.29	1.50

Duration of Labor and Delivery Observations

Beginning to End of Observation: The average duration of the labor and delivery observation period from beginning to end was 5.2 hours (SD=2.9, Range= 0.8 to 11.7, n=38).

Beginning to Time of Birth: The average duration from the beginning of the labor observation to the time when the baby was born was 3.4 hours (SD=3.0, Range=0.2 to 9.7, n=39). By hospital the average duration was: 2.1 hours at NRH, 3.8 hours at CRH, 4.0 hours at RRH, 4.6 hours at DH1, and 2.2 hours at DH2.

Birth to End of Observation: The duration of observation from birth to end of the postpartum observation averaged 2.1 hours (SD=0.5, Range=0.25 to 4.1, n=36).

Healthcare Worker Performance

Observations of 41 women in labor at five hospitals in Benin were analyzed to show the percentage of times that a task was performed. Results for the labor, intrapartum, and postpartum phases are displayed in Tables 8-15. In Tables 8 and 11-13, "missing" refers to blank data fields, or cases where the observer specifically checked that data were missing when it should not have been. "Not observed" refers to cases when the observer had to leave the observation area, or when the patient left the area and the observer could not follow, or when the observer left the response blank or indicated it was an inappropriate question for this case, such as an immediate delivery or referral.

Table 8. Labor monitoring with partograph (n=41)

	Partograph Alert Line				Partograph Action Line			
	Yes	No	Missing	Not Observed	Yes	No	Missing	Not Observed
Number of cases (%)	28 (68.3)	12 (29.3)	1 (2.4)	NA	25 (61.0)	11 (26.8)	5 (12.2)	NA

Table 9. Frequency of monitoring during labor

Task	Frequency of Task Performance (per hour)			Task Performed at Least Once		
	Mean (SD)	Range	n*	Number of Cases	%	n*
FHR checked in 1st hour†	1.61 (0.77)	1.0 to 4.0	41	41	100.0	41
FHR checked after 1st hour	0.78 (0.36)	0.3 to 1.7	22	24	66.7	36
Blood pressure checked	1.13 (1.24)	0.1 to 5.5	34	35	85.4	41
Pulse checked	0.66 (0.59)	0.2 to 2.1	15	15	40.5	37
Intervals between contractions checked	0.36 (0.26)	0.1 to 0.8	9	10	28.6	35
Duration of contraction checked	0.60 (0.57)	0.1 to 2.1	11	13	37.1	35
Vaginal exam	2.02 (1.46)	0.3 to 6.0	39	41	100.0	41

† FHR stands for "Fetal heart rate." Both "Frequency of Task Performance" and "Task Performed at Least Once" refer to cases. For example, 24 out of 36 cases had their FHR checked once or more after the 1st hour of observation during the labor phase.

* The sample sizes (n) are number of valid cases across all hospitals. The sample sizes for Frequency of Task Performance are equal to or less than for Task Performed at Least Once because of missing data on the duration of the observation period (a variable used to calculate frequency of task performance per hour).

Table 10. Frequency of monitoring during labor by hospital

Task	Frequency of Task Performance (per Hour)				
	NRH (n)	CRH (n)	RRH (n)	DH1 (n)	DH2 (n)
FHR checked in 1st hour	1.55 (11)	1.71 (7)	1.30 (10)	2.29 (7)	1.33 (6)
FHR checked after 1st hour	0.71 (4)	1.19 (5)	0.67 (4)	0.69 (7)	0.44 (2)
Blood pressure checked	1.20 (5)	0.94 (6)	1.14 (10)	0.56 (7)	1.93 (6)
Pulse checked	1.33(1)	1.10 (4)	0.33 (6)	0.54 (4)	NA
Intervals between contractions checked	NA	0.13 (1)	0.16 (2)	0.46 (6)	NA
Duration of contraction checked	0.14 (1)	0.93 (4)	0.16 (2)	0.60 (4)	NA
Vaginal exam	2.38 (9)	1.84 (7)	1.65 (10)	1.38 (7)	3.04 (6)

Note: NA = not available

Table 11. Performance during intrapartum phase

Indicator	Yes (%)	No (%)	Not observed (%)	Missing (%)
Hands washed**	5 (13.9)	27 (75.0)	4 (11.1)	0 (0.0)
Perineum cleaned**	14 (38.9)	20 (55.6)	2 (5.6)	0 (0.0)
New or re-sterilized gloves**	35 (97.2)	1 (2.8)	0 (0.0)	0 (0.0)
Sterile drapes & clothing**	2 (5.6)	33 (91.7)	0 (0.0)	1 (2.8)
Protect perineum**	34 (94.4)	0 (0.0)	2 (5.6)	0 (0.0)
Suction newborn*	0 (0.0)	25 (75.8)	3 (9.1)	5 (15.2)
One hand each side baby head**	33 (91.7)	0 (0.0)	3 (8.3)	0 (0.0)
Clamp & cut umbilical cord*	29 (87.9)	0 (0.0)	0 (0.0)	4 (12.1)
Use sterile instrument to cut cord*	33 (100)	0 (0.0)	0 (0.0)	0 (0.0)
Baby in skin-to-skin contact with mother*	19 (57.6)	13 (39.4)	0 (0.0)	1 (2.8)
Dry & cover newborn*	33 (100)	0 (0.0)	0 (0.0)	0 (0.0)
Give mother oxytocin**	28 (77.8)	1 (2.8)	2 (5.6)	5 (13.9)
Observe & manage delivery of placenta**	26 (72.2)	0 (0.0)	0 (0.0)	10 (27.8)
Confirm uterus is well-contracted**	34 (94.4)	2 (5.6)	0 (0.0)	0 (0.0)
Examine vulval-perineal region**	34 (94.4)	2 (5.6)	0 (0.0)	0 (0.0)
Examine birth canal**	20 (55.6)	14 (38.9)	1 (2.8)	1 (2.8)
Examine placenta**	26 (72.2)	7 (19.4)	3 (8.3)	0 (0.0)
Record number of blood vessels in cord*	5 (15.2)	22 (66.7)	6 (18.2)	0 (0.0)

(a) Of the 41 possible cases, 5 C-sections were excluded from all of the analysis, and 3 stillbirths were excluded from some of the analysis.
(b) Each case had an average of 11.8 tasks completed of the 18 listed above during the intrapartum phase (SD=1.4, Range 9 to 15, n=33).
(c) * = n of 33; ** = n of 36.

Table 12. Postpartum care of the mother

Indicator	Yes (%)	No (%)	Not Observed (%)	Missing (%)
Check uterine retraction**	34 (94.4)	2 (5.6)	0 (0.0)	0 (0.0)
Check external genitalia for hemorrhage**	34 (94.4)	2 (5.6)	0 (0.0)	0 (0.0)
Initiate breastfeeding within 2 hours of birth*	5 (15.2)	23 (69.7)	1 (3.0)	4 (12.1)
Check mother's temperature**	7 (19.4)	27 (75.0)	1 (2.8)	1 (2.8)

(a) Of the 41 possible cases, 5 C-sections were excluded from all of the analysis, 3 stillbirths were excluded from some of the analysis, and 1 missing item was observed for <2 hours.
(b) Each case had an average of 2.2 tasks completed of the 4 listed above during the postpartum/mother phase (SD=0.7, Range 0 to 4, n=33).
(c) * = n of 33; ** = n of 36.

Table 13. Postpartum care of the newborn

Indicator	Yes (%)	No (%)	Not Observed (%)	Missing (%)
Apply antimicrobial drop/ointment	36 (94.7)	0 (0.0)	0 (0.0)	2 (5.3)
Allow baby to breastfeed on demand	9 (23.7)	22 (57.9)	3 (7.9)	4 (10.5)
Keep infant under constant supervision	8 (21.1)	21 (55.3)	1 (2.6)	8 (21.1)
Clean blood and meconium from baby's skin	29 (76.3)	5 (13.2)	0 (0.0)	4 (10.5)

(a) Of the 41 possible cases, 3 stillbirths were excluded from all of the analysis. Missing information was from 2 C-section deliveries and 1 case observed for <2 hours.
(b) Each case had an average of 2.3 tasks completed of the 4 listed above during the postpartum/newborn phase (SD=0.7, Range 1–3, n=36).
(c) All four tasks had n = 38.

Table 14. Frequency summary: Postpartum

Postpartum	Frequency of Task Performance[a] (per hour)			Task Performed at Least Once[a]		
	Mean (SD)	Range	N[b]	Number of Cases	%	n[b]
Mother's pulse	0.57 (0.23)	0.1 to 1.1	25	28	80.0	35
Baby's color & respiration	1.38 (2.70)	0.4 to 16.0	32	35	100.0	35
Baby's temperature	0.63 (0.25)	0.4 to 1.0	7	8	29.6	27
Umbilical cord checked	0.73 (0.83)	0.4 to 4.0	18	19	65.5	29

(a) Both "Frequency of Task Performance" and "Task Performed at Least Once" refer to cases. For example, in 28 out of 35 cases the mother had her pulse checked once or more in the postpartum period.
(b) The sample sizes (n) are number of valid cases across all hospitals. The sample sizes are less for Frequency of Task Performance than for Task Performed at Least Once because of missing data on the duration of the observation period (a variable used to calculate frequency of task performance per hour).

Table 15. Frequency of postpartum monitoring by hospital

Indicator	NRH (n)	CRH (n)	RRH (n)	DH1 (n)	DH2 (n)
Mother's pulse checked	0.86 (3)	0.54 (4)	0.45 (7)	0.59 (5)	0.55 (6)
Baby's color & respiration checked	0.56 (7)	1.21 (5)	2.65 (8)	1.06 (6)	1.10 (6)
Baby's temperature checked	NA	0.72 (2)	NA	0.59 (5)	NA
Umbilical cord checked	0.49 (3)	0.56 (5)	4.00 (1)	0.61 (4)	0.48 (5)

Note: NA = not available.

Association between Team Characteristics and Task Performance

Several significant associations were found between number of providers on the team and task performance. All significant associations are positive; that is, more providers are associated with higher performance.

- Number of providers during labor is associated with frequency of checking the fetal heart rate in the first hour of observation (r=.40, p=.030, n=29).
- Number of providers during the intrapartum phase is not associated with task performance during the intrapartum phase.
- Number of providers during postpartum care for mothers is not associated with task performance during the postpartum phase.
- Number of providers during postpartum care for neonates is associated with frequency of checking color and respiration (r=.41, p=.029, n=28).

3. Retrospective Chart Review of Obstetric Complications

Basic Information and Missing Data

We reviewed 57 charts in four hospitals of women who experienced postpartum hemorrhage, pre-eclampsia/eclampsia, or sepsis. Tables 16-18 report the number of charts reviewed, type of delivery, and pregnancy outcome.

Many of the questions required the reviewer to respond whether or not some task was recorded as having been done (yes or no), or if data were inadequate or missing from the charts, to check one of the pre-coded reasons: not in chart, illegible, inconsistent, an inappropriate question for that case. In some cases no response was recorded by the reviewer. Missing and inadequate data were divided into two categories: "missing" referring to cases where the observer specifically checked that data was missing, illegible or inconsistent on the review form, and "not observed" referring to cases where the observer left the response blank or indicated it was an inappropriate question for this case, such as might occur in an immediate delivery or referral.

"Valid N" for a data item equals the number of all charts reviewed minus the number of charts categorized as "not observed" for that data item. Throughout this section, we estimate percentage of yes responses by dividing the number of yes responses by Valid N. A minimal estimate of percentage of yes responses (min estimate) can be calculated using the total number of charts as the denominator, and an upper bound estimate (max estimate) by using the sum of the yes and no responses as the denominator.

Table 16. Number of charts reviewed, by hospital

Hospital	N	%
NRH	18	31.6
CRH	15	26.3
RRH	15	26.3
DH1	9	15.8
Total	**57**	**100.0**

Table 17. Type of delivery: Chart review

Delivery Type	N	%
Spontaneous	10	17.5
Forceps	1	1.8
Cesarean	29	50.1
Other	6	10.5
Missing and not observed	11	19.3

Table 18. Pregnancy outcomes: Chart review

Outcome	N	%
Live birth	36	63.2
Fetal death	8	14.0
Spontaneous abortion	1	1.8
Missing and Not observed	12	21.0

Postpartum Hemorrhage

Seventeen cases of postpartum hemorrhage were reviewed: 6 from NRH, 4 from CRH, 5 from RRH, and 2 from DH1. The quality of care received on eight yes-no indicators was scored for each case, as shown in Table 19. The pooled score over all 8 indicators for all charts was 72.0 percent (90 yes answers out of

125), and ranged from a low of 28.6 percent (massaged uterus) to a high of 100 percent (vaginal bleeding assessed). The pooled minimum estimate is 66.2 percent, and the pooled maximum estimate is 85.7 percent. The results are less reliable when broken out by hospital, due to small samples per hospital (Table 20).

Table 19. Quality of care for postpartum hemorrhage: Chart review

Indicator	Number of Charts (n=17)					
	Yes	No	Missing	Not Observed	Valid N	% Yes
Signs of shock assessed	7	6	4	0	17	41.2
Vaginal bleeding assessed	17	0	0	0	17	100
Examined cervix for tears	14	2	0	1	16	87.5
Massaged uterus	4	3	7	3	14	28.6
Oxytocin given	16	0	1	0	17	94.1
IV infusion started	16	0	1	0	17	94.1
Catheterized bladder	6	4	4	3	14	42.9
Checked placenta	10	0	3	4	13	76.9
Total	**90**	**15**	**20**	**11**	**125**	**72.0**

Table 20. Quality of care for postpartum hemorrhage by hospital: Chart review

Indicator	NRH (n=6)			CRH (n=3)			RRH (n=6)			DH1 (n=2)		
	Yes	Valid N	% Yes	Yes	Valid N	% Yes	Yes	Valid N	% Yes	Yes	Valid N	% Yes
Signs of shock assessed	1	6	16.7	1	3	33.3	5	6	83.3	0	2	0.0
Vaginal bleeding assessed	6	6	100.0	3	3	100.0	6	6	100.0	2	2	100.0
Examined cervix for tears	6	6	100.0	2	3	66.7	4	5	80.0	2	2	100.0
Massaged uterus	1	6	16.7	2	3	66.7	1	3	33.3	0	2	0.0
Oxytocin given	6	6	100.0	3	3	100.0	5	6	83.3	2	2	100.0
IV infusion started	5	6	83.3	3	3	100.0	6	6	100.0	2	2	100.0
Catheterized bladder	3	6	50.0	2	3	66.7	1	3	33.3	0	2	0.0
Checked placenta	5	5	100.0	3	3	100.0	2	3	66.7	0	2	0.0
Total	**33**	**47**	**70.2**	**19**	**24**	**79.2**	**30**	**38**	**78.9**	**8**	**16**	**50.0**

Pre-eclampsia and Eclampsia

Twenty-five cases of pre-eclampsia/eclampsia were reviewed: 12 from NRH, 5 from CRH, 7 from RRH, and 2 from DH1. The quality of care received on nine yes-no indicators was scored for each case, as shown in Table 21. The pooled score over all 9 indicators for all charts was 53.4 percent (101 yes answers out of 189), and ranged from a low of 0 percent (placed on left side) to a high of 100 percent (blood pressure and fetal condition assessed). The pooled minimum estimate is 44.9 percent, and the pooled maximum estimate is 69.2 percent. The results are less reliable when broken out by hospital, due to small samples per hospital (Table 22).

Table 21. Quality of care for pre-eclampsia and eclampsia: Chart review (n=25 charts)

Indicator	Yes	No	Missing	Not Observed	Valid N	% Yes
Blood pressure assessed	24	0	0	1	24	100
Fetal condition assessed	23	0	0	2	23	100
Checked for proteinuria	7	12	5	1	24	29.2
Parenteral Magnesium Sulfate given	13	7	4	1	24	54.2
Parenteral Hydralazine given	6	9	6	4	21	28.6
Monitored respirations	8	5	10	2	23	34.8
Placed on left side	0	6	16	3	22	0.0
Delivered within 12 hrs onset of convulsions	13	5	1	6	19	68.4
Delivered within 24 hrs if severe pre-eclampsia	7	1	1	16	9	77.8
Total	**101**	**45**	**43**	**36**	**189**	**53.4**

Table 22. Quality of care for pre-eclampsia and eclampsia by hospital: Chart review

Indicator	NRH (n=6)			CRH (n=3)			RRH (n=6)			DH1 (n=2)		
	Yes	Valid N	% Yes	Yes	Valid N	% Yes	Yes	Valid N	% Yes	Yes	Valid N	% Yes
Blood pressure assessed	11	11	100.0	4	4	100.0	7	7	100.0	2	2	100.0
Fetal condition assessed	11	11	100.0	5	5	100.0	5	5	100.0	2	2	100.0
Checked for proteinuria	1	11	9.1	1	4	25.0	5	7	71.4	0	2	0.0
Parenteral Magnesium Sulfate given	5	10	50.0	4	5	80.0	3	7	42.9	1	2	50.0
Parenteral Hydralazine given	1	10	10.0	0	4	0.0	4	5	80.0	1	2	50.0
Monitored respirations	4	11	36.4	2	4	50.0	2	6	33.3	0	2	0.0
Placed on left side	0	11	0.0	0	4	0.0	0	5	0.0	0	2	0.0
Delivered within 12 hours of onset of convulsions	4	8	50.0	4	5	80.0	3	4	75.0	2	2	100.0
Delivered within 24 hours if severe pre-eclampsia	4	5	80.0	1	1	100.0	2	3	66.7	0	0	NA
Total	**41**	**88**	**46.6**	**21**	**36**	**58.3**	**31**	**49**	**63.3**	**8**	**16**	**50.0**

Sepsis

Sepsis was defined to include chorioamnionitis, puerperal sepsis, and septic abortion. Twenty-four cases of sepsis were reviewed: 4 from NRH, 9 from CRH, 6 from RRH, and 5 from DH1. The quality of care received on three yes-no indicators was scored for each case, as shown in Table 23. The pooled score over all 3 indicators for all charts was 90.1 percent (64 yes answers out of 71). The pooled minimum estimate is 88.9 percent, and the pooled maximum estimate is 91.4 percent. The results are less reliable when broken out by hospital, due to small samples per hospital (Table 24).

Table 23. Quality of care for sepsis: Chart review

Indicator	Number of Charts (N=24)					
	Yes	No	Missing	Not Observed	Valid N	% Yes
Fever assessed	24	0	0	0	24	100.0
Foul smelling vaginal discharge assessed	16	6	1	1	23	69.6
Combination of antibiotics given	24	0	0	0	24	100.0
Total	**64**	**6**	**1**	**1**	**71**	**90.1**

Table 24. Quality of care for sepsis by hospital: Chart review

Indicator	NRH (n=4)			CRH (n=9)			RRH (n=6)			DH1 (n=5)		
	Yes	Valid N	% Yes	Yes	Valid N	% Yes	Yes	Valid N	% Yes	Yes	Valid N	% Yes
Fever assessed	4	4	100.0	9	9	100.0	6	6	100.0	5	5	100.0
Foul smelling vaginal discharge assessed	2	3	66.7	5	9	55.6	5	6	83.3	4	5	80.0
Combination of antibiotics given	4	4	100.0	9	9	100.0	6	6	100.0	5	5	100.0
Total	**10**	**11**	**90.9**	**23**	**27**	**85.2**	**17**	**18**	**94.4**	**14**	**15**	**93.3**

Missing and Not Observed Data Items

A large number of data items were missing or not observed, as summarized in Table 25. (See also Tables 19, 21, and 23.) Overall, 15 percent of data items were missing and 11 percent were not observed. Across complications, the largest percentage of missing data items was in eclampsia with nearly 20 percent missing, compared to under 2 percent in sepsis. Across hospitals, DH1 had the highest percentage of missing items (21.4 percent).

Table 25. Missing and not observed data items by hospital and by complication: Chart review

Hospital (N for PPH, Ecl, Sep)	PPH Data Items (% of N)		Eclampsia Data Items (% of N)		Sepsis Data Items (% of N)		Total Data Items (% of N)	
	Missing	Not Observed	Missing	Not Observed	Missing	Not Observed	Missing	Not Observed
NRH (N = 48, 99, 12=159)	9 (18.8)	1 (2.1)	17 (17.2)	11 (11.1)	0 (0.0)	1 (8.3)	26 (16.4)	13 (8.2)
CRH (N = 24, 45, 27 = 96)	1(4.2)	0 (0.0)	10 (22.2)	9 (20.0)	1 (3.7)	0 (0.0)	12 (12.5)	9 (9.4)
RRH (N = 48, 63, 18=129)	6 (12.5)	10 (20.8)	11 (17.5)	14 (22.2)	0 (0.0)	0 (0.0)	17 (13.2)	24 (18.6)
DH1 (N = 16, 18, 15=49)	4 (25.0)	0 (0.0)	5 (27.8)	2 (11.1)	0 (0.0)	0 (0.0)	9 (18.4)	2 (4.1)
Total (N = 136, 225, 72=433)	**20 (14.7)**	**11 (8.1)**	**43 (19.1)**	**36 (16.0)**	**1 (1.4)**	**1 (1.4)**	**64 (14.8)**	**48 (11.1)**

Note: The sample size (N) for data items for a particular complication and hospital equals the number of charts reviewed in the hospital with that complication times the number of indicators for that complication.

D. Discussion

1. Data Collection

Of the three studies, the Enabling Environment study had the largest number of data collection instruments and perhaps also the most complex. The Essential Elements data collection form (B.2.5) is relatively easy to use but difficult to analyze because of the many types of medications and dosages. The form used to record the direct observation of care during normal labor and delivery (B.2.4) sometimes requires the observer to stay focused over a long period of time in order to monitor the care provided during labor when the labor extends over many hours. To save time, observers may try to monitor 2 or 3 labor cases at once using this instrument, but this can lead to questionable data when one (or more) of the cases goes to the delivery phase. It may be advisable to monitor only one labor at a time in future data collections. The form used to do a chart review of obstetric complications (B.4.2) requires a reviewer with a strong clinical background and qualifications to interpret the data, often ambiguous, in the charts. The Motivation Questionnaire (B.2.2) and Enabling Factors Questionnaire (B.2.3) seem to work well.

2. Results of the Observations

The vast majority of staff attending the first three phases (labor, delivery, postpartum-mother) have extensive professional training (nurses or more). Nevertheless, less than half said they had received any

training in the last two years. The last phase (postpartum-neonate) was attended by staff with much less professional training than the other phases. In 27 out of 34 cases (79.4 percent), postpartum neonate care was provided by an auxiliary or "other" staff, and not by consultant physicians, residents, interns, midwives or nurses.

Labor monitoring appears to be very inadequately performed. WHO guidelines indicate that the Fetal Heart Rate (FHR) should be measured every 5 minutes (12 times per hour) during the first hour and every 15 minutes (4 times per hour) after that. In fact, the data from the direct observation indicate that FHR is only measured on average 1.6 times per hour in the first hour of labor, and only 0.8 times per hour thereafter. Thus, many cases were not measured sufficiently often to pick up fetal distress.

A similar failing was apparent for monitoring of the mother. For example, the guidelines state that blood pressure and duration of contractions should be measured two times per hour, but on average, the mother's blood pressure was measured 1.1 times per hour and contractions were measured 0.6 times per hour. In contrast, vaginal exams were being performed on average more than twice per hour, much more frequently than necessary or appropriate in most cases. Infrequent labor monitoring means that many complications might not be noticed in time to take appropriate corrective action. However, some mothers arrive at the facility at the end of labor, already in the intrapartum phase or even after delivery. In these cases, there is no opportunity for labor monitoring.

Providers used a partograph in about two-thirds of observed cases. The alert line was completed 68.3 percent of the time (28/41, 0 not observed); the action line 61.0 percent of the time (25/41, 0 not observed).[1]

The following practices were observed during the intrapartum phase:

- In 15.6 percent of the cases (5/32, 4 not observed) the staff washed their hands before attending the patient.
- In none of the cases (0/30, 3 not observed) did the staff suction the newborn.
- In 41.2 percent of the cases (14/34, 2 not observed) the staff cleaned the perineum.
- In 82.4 percent of the cases (28/34, 2 not observed) the staff gave the mother oxytocin.
- In 57.1 percent of the cases (20/35, 1 not observed) the staff examined the birth canal.

As can be seen, performance varies, with very few washing their hands or suctioning the newborn, but oxytocin was given to the mother after delivery in 82.4 percent of the cases.

During the first two hours postpartum, both the uterine retraction and the external genitalia were checked at least once in 94.4 percent of the cases (34/36, 0 not observed). However, the mother's temperature was checked at least once in only 20.0 percent (7/35, 1 not observed) of the cases. There was similar variation in monitoring performance of newborns during the postpartum phase. Antimicrobial ointment was applied in 94.7 percent of the cases (36/38, 0 not observed), and the baby was cleaned of blood and meconium in 76.3 percent of the cases (29/38, 0 not observed). On the other hand, the newborn was under constant surveillance in only 21.6 percent of the cases (8/37, 1 not observed).

The data obtained from the charts of patients with maternal complications indicated that many tasks were performed to standard. Of the three complications reviewed, sepsis management was the best and pre-eclampsia the worst, with postpartum hemorrhage in the middle. For pre-eclampsia, the following tasks were performed infrequently: checking for proteinuria, monitoring respirations, and placing on left side.

[1] The percent performed correctly assigns 'yes' responses to the numerator, and the sum of 'yes', 'no', and 'missing' to the denominator. 'Not observed' are not included in the calculation. This same definition is used for all percent calculations in this section.

Similarly, assessing signs of shock, massaging the uterus, and catheterizing the bladder were all done only infrequently for hemorrhage.

However, 25.1 percent of the data from the charts was not there ("missing" or "not observed"). This included 21.8 percent from hemorrhage cases, 35.1 percent from pre-eclampsia cases, and only 2.8 percent from sepsis cases. If these data were not missing, their inclusion could significantly influence the figures reported here for hemorrhage and pre-eclampsia case management. While the missing data from the charts of pre-eclampsia and hemorrhage cases could raise the performance significantly, they could also lower it even below were it is now. The more conservative approach is to assume that cases with less information are cases where management has been inadequate. This has been done in part in the currently reported figures, which include "missing" data in the denominator but not "not observed" data. Including the "not observed" data in the denominator would lower the reported performances from the current level.

Third Delay Study

A. Objectives

Objectives for the Third Delay Study included the following:

- Define and measure the third delay for the treatment of obstetrical emergencies within facilities.
- Develop methods to measure the time interval for components of intra-facility emergency obstetric (OB) care and document apparent factors related to delayed care.
- Develop measures useful for monitoring changes that occur after quality improvement interventions.

B. Methods

To measure components of the third delay, we employed patient flow analysis in three of the five study hospitals: the referral hospital in Cotonou, the church hospital in Cotonou and the regional hospital in Porto Novo. These three hospitals were chosen because they represented different levels of care but also treated enough obstetric complications to permit observation of at least a minimal number of cases within the time available for data collection. Record review was carried out at all study hospitals except DH2, which does not maintain medical records. As shown in Table 1, the local study team completed a total of 29 patient flow observations and 73 medical record audits.

To analyze patient flow, we recorded the time at which 13 key events occurred for each observed patient:

1. The time of the woman's arrival at the hospital entrance.
2. The time of arrival at the entrance to the emergency room/obstetric ward.
3. The time of entry into the emergency room/obstetric ward.
4. The time vital signs were first taken.
5. The time of the first exam by a midwife or other health professional.
6. The time at which care was first administered by a midwife or other health professional.
7. The time at which a specialist was called, if this occurred.
8. The time at which a specialist first examined the patient, if this occurred.
9. The time at which a specialist examined the patient for a second time, if this occurred.
10. The time at which a specialist examined the patient for a third time, if this occurred.
11. The time at which a specialist gave verbal or written orders for testing or treatment.
12. The time of administration of each of these verbal or written orders.

13. The time at which a discharge order was issued and carried out and patient's condition at discharge (hospitalized, referred, discharged to home, discharged against medical advice, deceased).

The study team determined which events in the sequence of care to measure after extensive discussion with its local clinician observers. Local study team members explained that after arriving at the hospital, a woman might have to wait for someone to open the main gate. Once inside the compound, she would have to find her way to the entrance of the emergency room/obstetric ward, where she might have to wait once again to gain entry. Once inside the emergency room/obstetric ward, the woman might have vital signs and other initial information recorded by a nurse or a security guard and would then be attended by a midwife. Depending on her condition, the midwife might decide to call a specialist who might be on the ward, in another part of the hospital, or somewhere outside. Hence there might be a significant wait between the time a specialist was called and the time he or she saw the patient. To capture this information, we stationed one observer (a retired physician) at the hospital gate to record the time of arrival of each woman with an obstetric complication. The gate observer determined the motive for the woman's visit by asking her or those attending her as they passed through the gate, then recorded her name and arrival time on a log. We stationed a second observer (a *sage-femme*), outside the door to the emergency room/obstetric ward to record the each woman's arrival time at this door. A third observer (an Ob/Gyn), then noted the time of key events once the woman entered the emergency room/obstetric ward.

To distinguish the time a patient spent with a health professional ("useful time") from the time she spent waiting ("non-useful time"), we recorded both start and end times for each key event after her entry into the emergency room/obstetric ward. For administration of medication, we defined the start time as the time at which a health professional arrived with the medication and the end time as the time at which the medicine was administered, but not necessarily completely consumed. For instance, in the case of a medication administered via IV drip, the end point would be the time at which the nurse finished injecting the medication into the IV line, not the time at which the IV fluid was completely absorbed by the patient. In the same manner, the end point for administration of IV fluids would be the time at which the IV line began to function. For laboratory tests such as analysis of blood or urine, the start point was defined as the time at which the health professional arrived at the patient's bedside with the test-taking supplies. The end point was defined as the time at which test results became available. This might vary widely depending on whether a test could be carried out by the provider at bedside, required laboratory analysis or depended upon the patient or a member of her family purchasing supplies.

Observers worked 12-hour shifts, some during the day (e.g., 07:00–21:00), some in the afternoon/evening (e.g., 13:00–01:00) and some at night (e.g., 20:00–12:00). At each hospital, observers collected data during at least two daytime shifts (06:00–18:00) and two night shifts (18:00–06:00), one set during the week, another on a Saturday or Sunday. Observers returned to each facility's medical records office 15–30 days after each observation to look for all patient histories and note final diagnoses and other information about management of each case.

The obstetrician and physician/anesthesiologist were selected to carry out the medical record review because of their clinical expertise and their experience working with clinical records. Cases with each of the following discharge diagnoses were purposefully selected from among all cases of obstetric complications that occurred in the three months prior to the study in each hospital:

1. Postpartum hemorrhage
2. Severe pre-eclampsia
3. Eclampsia
4. Obstructed labor (cephalo-pelvic disproportion)
5. Chorioamnionitis
6. Puerperal sepsis
7. Septic abortion

8. Post-abortion vaginal, uterine or intestinal lesions

Once selected, each medical record was reviewed using a form designed to capture information about the initial exam performed in emergency room and on the OB ward, the diagnosis, and the definitive treatment. More detailed questions were included for postpartum hemorrhage, pre-eclampsia or eclampsia, and sepsis, endometritis or chorioamnionitis. As noted above, this more detailed information was used to evaluate performance at managing obstetric complications for the Enabling Environment study.

C. Results

1. Medical Record Reviews

A total of 73 medical records were reviewed; 21 at the national tertiary referral hospital (NRH), 17 at the church referral hospital (CRH), 25 at the regional referral hospital (RRH), and 10 at the district hospital (DH1). Of these 73, 41 patients delivered by C-section, 42 patients were emergency incoming transfers, there were 11 fetal deaths and 47 live births. For the 73 patients there were 86 diagnoses that fit the study criteria as 15 patients had dual diagnoses and 2 had no diagnosis (Table 26).

Table 26. Number of records reviewed by type of OB emergency

Type of OB Emergency	Number of Records Reviewed (n = 73)
Postpartum hemorrhage	15
Eclampsia/severe pre-eclampsia	27
Obstructed labor	17
Sepsis (chorioamnionitis and puerperal sepsis	18
Post-abortion complications (septic abortion and uterine lesions)	9
Dual diagnoses	15

Note: Total does not equal 73 because some patients had more than one complication.

The record reviewer, a practicing Ob/Gyn, determined if there was a delay at three different points in the care of the patient. At the initial evaluation the reviewer determined if there had been a delay in evaluating the patient based on the information available in the chart. If the patient had not been evaluated on arrival, or if the patient had not been monitored adequately, resulting in a delayed recognition of an OB emergency, these would be examples of delays in the initial evaluation. The reviewer next determined if there was a delay in the diagnosis of the OB emergency based on their expert judgment and the information available in the record. Table 27 displays the results by diagnosis category. Of the 73 records reviewed, 12 (16 percent) had at least one type of delay according to the reviewer. There were 5 cases (6.8 percent) which had delays in the initial evaluation and 10 cases (13.7 percent) with delays in the diagnosis. The greatest number of delays was in the diagnosis, especially for patients with eclampsia/pre-eclampsia or obstructed labor. Although we had intended to review delays in the definitive treatment, those data were not collected as the data collection tool was missing part of the last page.

Table 27. Number of cases with delays in initial evaluation, diagnosis, and definitive treatment for 5 major OB emergencies

Type of OB Emergency	Delay in Initial Evaluation (n = 5)	Delay in Diagnosis (n = 10*)	Total
Postpartum hemorrhage	1	1	2/15 (13.3%)
Eclampsia/severe pre-eclampsia	1	6	7/27 (25.9%)
Obstructed labor	2	3	5/17 (29.4%)
Sepsis (chorioamnionitis and puerperal sepsis)	1	1	2/18 (11.1%)
Post-abortion complications (septic abortion and uterine lesions)	0	0	0

* One case with dual diagnosis of chorioamnionitis and obstructed labor.

Examples of reasons for delays by type of delay are listed below in Table 28.

Table 28. Examples of reasons for delays

Type of Delay	Examples
Delay in Initial Evaluation	Arrived at night or on weekend
	Waited 13 hours for initial exam, personnel not available
Delay in Diagnosis	Arrived at night or on weekend
	Incorrect diagnosis
	Missed diagnosis, no sonogram
	Missed diagnosis, 30 min after evaluation patient seized
	Uterine rupture not diagnosed during hospitalization
	Personnel not available
	Partograph not well used
	Patient not well managed during labor
Delay in Definitive Treatment	Arrived at night or on weekend
	Personnel not available
	No treatment as diagnosis was missed
	Medications lacking

Time Intervals from Diagnosis to Definitive Treatment

As calculated by one-way analysis of variance and shown in Table 29, we were able to calculate time intervals in minutes from diagnosis to definitive treatment from only 47 of 86 of the diagnoses (54.7 percent). Records had information missing on the time of diagnosis. An Analysis of Variance was conducted to determine if the average time was significantly different between the four hospitals. As there were outliers within each set of time intervals, we calculated the overall mean and the interquartile range (25^{th} to 75^{th} percentile) indicating how the middle 50 percent of the distribution is scattered.

Table 29. Mean time interval between diagnosis and administration of definitive treatment, by hospital in minutes

Diagnosis	NRH	CRH	RRH	DH1	Overall Mean (25th–75th percentile)
Postpartum hemorrhage Oxytocin: N = 5	25 n=3	0 n=1	130 n=1	–	41 (0–40 mins)
Pre-eclampsia / eclampsia Anti-hypertensives:N = 14 (NS)	242 n=7	12 n=3	398 n=4	–	237 (19–591 mins)
Pre-eclampsia / eclampsia Anticonvulsants:* N = 12 (NS)	187 n=5	29 n=4	113 n=3	–	116 (20–136 mins)
Obstructed labor C-Section: N = 12 (NS)	677 n=4	100 n=2	468 n=4	510 n=2	485 (164–753 mins)
Sepsis Antibiotics: N = 8 (NS)	120 n=1	189 n=4	541 n=3	–	312 (86–375 mins)
Post-abortion complications N = 8 (NS)	340.0 n=1	65 n=2	628 n=3	168 n=2	336 (60–704 mins)

* Notes: Magnesium sulfate was not used at these hospitals in Benin. Of 3 blood transfusions, times were 1hr 33 min, 3 hr 7 min, 7 hrs.

Time Intervals from Order to Definitive Treatment

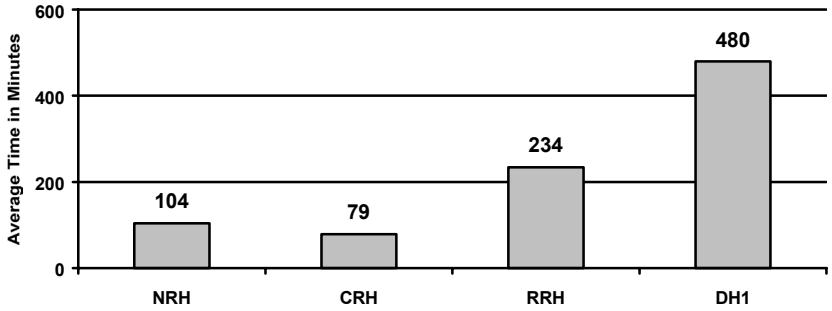
We were able to calculate time intervals from order to administration of definitive treatment for 61 treatments for 86 diagnoses (70.9 percent). As there were outliers within each set of time intervals, we calculated the overall mean and the interquartile range (25^{th} to 75^{th} percentile) indicating how the middle 50 percent of the distribution is scattered.

Table 30. Mean time interval between order and administration of definitive treatment, by hospital in minutes

Treatment	NRH	CRH	RRH	DH1	Overall Mean (25^{th}–75^{th} percentile)
Antibiotic N = 13 (NS)	150 n=3	157 n=4	372 n=4	68 n=2	208 (60–227 mins)
Oxytocin N = 5 (P = .08)	330 n=1	113 n= 2	–	111 n=2	111 (0–230 mins)
C-Section N = 28 (NS)	104 n=11	79 n=8	234 n=7	480 n=2	164 (49–140 mins)
Blood Transfusion N = 4 (P = .035)	0 n=1	455 n=2	120 n=1	–	258 (30–460 mins)
Anti-hypertensive N = 7 (NS)	223 n=4	15 n=1	331 n=2	–	224 (50–611 mins)
Anticonvulsant N = 4 (NS)	115 n=2	45 n=1	45 n=1	–	80 (45–124 mins)

Table 30 presents the average time interval in minutes between the order and the administration of several definitive treatments for obstetric emergencies by hospital in Benin. The difference was calculated by subtracting the time of administration from the time of the order. An analysis of variance was conducted to determine if the average time was significantly different between the four hospitals. An illustration of the difference by hospital in the interval between decision for C-section and start of C-section is presented in Figure 1. The largest reference hospital, NRH Hospital had an average time interval of 104 minutes, compared to 79 minutes at CRH, 234 minutes at RRH, and 480 minutes at DH1. Although these differences were not significant due to the small sample size, they illustrate the delays encountered at the smallest hospital.

Figure 1. Time to C-section in minutes by hospital

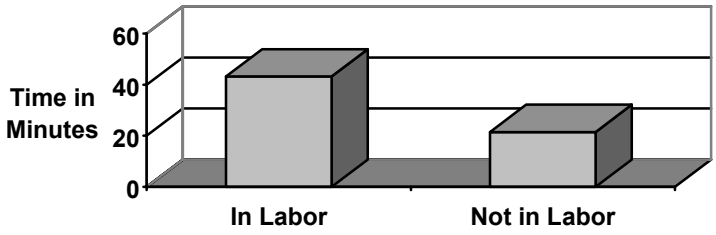


2. Patient Flow Analysis

Arrival to Initial Evaluation: A total of 29 emergency maternity patients were observed during the patient flow analysis at three hospitals in Benin (12 observations at NRH, 5 at CRH, and 12 at RRH). Of these 29, 17 were in labor and 12 were not. Sixteen of the 29 were incoming transfers. Time intervals were measured from arrival at the facility gate to initial evaluation or from entry into the OB ward to initial evaluation. For each time interval women not in labor were evaluated the fastest, followed by women in labor (see Figures 2 and 4). The mean time for all patients arriving at all hospitals for the time interval from arrival to initial evaluation was 33.7 minutes. The mean time interval for all patients from arrival to initial evaluation was the longest at RRH (53.7 minutes) and the shortest at NRH (16.2 minutes, see Figure 3).

Figure 2. Time interval from arrival at hospital to initial evaluation all hospitals

($F_{(1, 23)}$ = 1.32, p = .263)



Time to C-section: We were able to measure the time interval between decision for a C-section and start of C-section for 7 patients: 3 at NRH, 1 at CRH and 3 at RRH. Of the 7 patients, 1 was diagnosed as cephalo-pelvic disproportion (CPD), 2 had fetal distress, 1 was a shoulder presentation and 3 were repeat C-sections, one of whom also had fetal distress. In the first hour after the decision to operate, surgery had begun on only 2 of the 7 cases. In the second hour after the decision, 2 more C-sections were begun. The remaining 3 took 3 hours 23 minutes, 4 hours and 7 hours 23 minutes to begin after the decision to

Figure 3. Time interval from arrival at hospital to initial evaluation by hospital
($F_{(2, 22)} = 1.71$, $p = .204$)

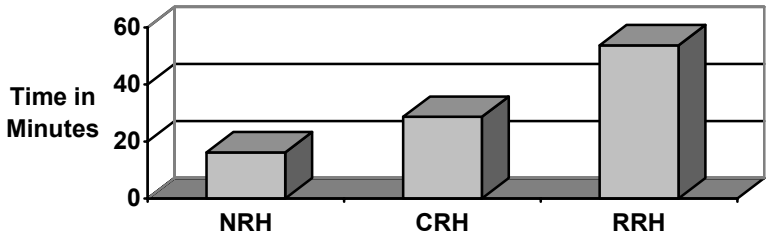
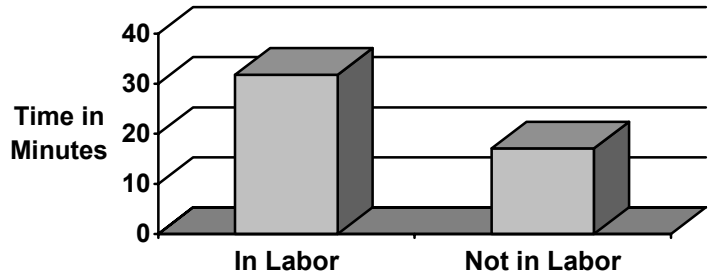


Figure 4. Time interval from entry into OB to initial evaluation
($F_{(1, 25)} = 1.10$, $p = .304$)



operate. The mean time from decision to operate and start of C-section in Benin was 2 hours 43 minutes (range 27 minutes to 7 hours 23 minutes).

Time from Diagnosis to Definitive Treatment: There was 1 patient diagnosed with obstructive labor where we were able to measure the time interval between the diagnosis of obstructive labor and beginning of C-section, the definitive treatment. This patient was delivered 54 minutes after arrival as an incoming transfer with diagnosis of CPD. One patient with postpartum hemorrhage after a home delivery had a manual removal of the placenta completed 44 minutes after arrival at the hospital. Within 17 minutes of arrival a patient with postpartum eclampsia had received diazepam IV.

Third Delays: Of the 29 patients observed during patient flow analysis in Benin, 12 (41.4 percent) had a delay in their care. Reasons for the delays were as follows:

- Arrived at 8:34. Did 2 uterine revisions, 1st at 8:55 and 2nd at 10:35 with no effect. At 11:10 sutured cervix with no effect. Reason for delay was incorrect diagnosis as uterus was ruptured. Hysterectomy for intractable bleeding at 12:40. Didn't monitor blood pressure/pulse as requested.
- Both operating rooms were in use for other surgeries. Surgeons and anesthetist were busy. C-section ordered at 14:10 and started at 17:33. Reason for C-section was fetal distress.
- Prescription given to patient's parents who took their time buying medication (1 hour 45 minutes).
- Decision for C-section at 2:30; C-section at 6:30; operating room occupied and surgeon busy. Patient transferred to operating room twice, reason for C-section was fetal distress.
- Arrived at 20:55, evaluated at 21:02, orders at 23:07. Patient didn't buy antibiotic medications. Not given until 05:30, 3 days later. Curettage not done until 4 days later.

- Took an hour to get anesthesiologist at night. Arrived at 21:25, decision for C-section at 22:00, C-section began at 23:45. Called physician and anesthesiologist by sending ambulance at 22:10. They arrived at 23:02.
- Arrived at 20:05, incoming transfer with history of 3 days of labor, evaluated at 20:10, oxytocin at 01:20, delivered at 01:35, 5 hours 30 minutes after arrival.
- Arrived at 23:30, evaluated at 00:37, started IV at 01:38, breech delivery at 02:52.
- Arrived at 23:50, evaluated at 00:55, physician evaluation and echo at 02:40, trial of labor ordered at 02:40. Not started until 04:05.
- Arrived at 03:35, evaluated at 03:55, IV started at 04:20. Tried manual extraction at 06:00 which failed; decision for laparotomy at 06:45, observers left at 07:00.
- Arrived at 8:30, evaluated at 10:15, MD called at 11:00, arrived at 12:50, decision for C-section at 12:15, C-section at 20:20. Not clear why there was a delay.

D. Discussion

In Benin, most of the delays found in the record review occurred during diagnosis, especially for obstructed labor and severe pre-eclampsia/eclampsia. The reasons cited were poor management during labor and poor use of the partograph. Delays in treatment, however, were not abstracted from the medical record. Calculating the time intervals between diagnosis and treatment and order and administration of treatment were hampered due to missing times in the records. There was more documentation of times at NRH and CRH and less documentation at RRH and DH1. Times were available more often for C-sections than for the order and administration of oxytocin and antibiotics. Overall, the diagnoses with the shortest response time were postpartum hemorrhage, followed by severe pre-eclampsia/eclampsia, sepsis, post abortion complications, and obstructed labor. All hospitals except CRH had long periods of time between the diagnosis of obstructed labor and the definitive treatment, a C-section. For treatments, where a time interval could be calculated, the administration of an anti-convulsant was the fastest, followed by the administration of oxytocin, then a C-section, antibiotics, anti-hypertensives and lastly a blood transfusion. Of these emergency treatments, only anti-convulsants and oxytocin were given on average less than 2 hours after the order.

Based on these findings, we would recommend implementing an initiative to improve medical record documentation at all hospitals, especially at RRH and DH1. This would facilitate a medical record review for quality purposes. To improve the administration times for all treatments, a quality improvement approach could be initiated to identify delays and improve the process of administering treatments. Since the most common delays were in the diagnosis of obstructed labor and severe pre-eclampsia/eclampsia, special focus should be brought to bear on the monitoring of labor, use of the partograph and diagnosis of severe pre-eclampsia.

The waiting times, after arrival at the hospital or the OB department, varied by hospital. The longest length of time occurred at RRH, an average of almost an hour (54 minutes). We recommend that a quality improvement approach, to develop a systematic triage and assessment of all incoming patients, be used to reduce waiting times in RRH.

Appendix A: Study Instruments

Code	Name/Description
1. Study of the Competency of Skilled Birth Attendants	
B.1.1	Evaluation des Connaissances
B.1.2	Etudes de Cas: Utilisation du Partographe
B.1.3	Fréquence et difficultés perçues des techniques cliniques
B.1.4	Liste de contrôle: réanimation du nouveau-né avec Masque & ballon Ambu
B.1.5	Liste de contrôle: Réanimation du Nouveau-né par le bouche a bouche (et nez)
B.1.6	Liste de contrôle: Extraction Manuelle du Placenta Sur simulation avec mannequin
B.1.7	Liste de contrôle: Compression Bimanuelle de l'Utérus avec mannequin
B.1.8	Liste de contrôle: pose de voie d'abord veineux avec mannequin
2. Study of the Enabling Environment for Skilled Attendance at Delivery	
B.2.1	Facteurs Favorisants pour la Salle de Travail et d'accouchement
B.2.2	Questionnaire sur la Motivation
B.2.3	Questionnaire sur la Présence de Facteurs Favorables
B.2.4	Performance Dans la Prise en Charge des 3 Etapes du Travail et de l'accouchement Normaux
B.2.5	Questionnaire sur les Eléments Essentiels de la Prise en Charge de l'accouchement - pour la Salle d'accouchement, la Salle d'urgence, la Pharmacie de Détail
3. Study of In-Hospital Delays in Obstetric Care	
B.3.1.A	Registre des ARRIVEES S1 – A remplir par l'observateur des arrivées
	Registre des ARRIVEES S2 – A remplir par l'observateur des arrivées
B.3.1.C	Diagnostic final de l'examen médical en salle d'urgence / d'accouchement
B.3.2	Flux de Patientes (salle d'urgence et/ou d'accouchement)
4. Common instruments	
B.4.1	Remplir cette fiche au niveau de chaque hôpital où cette étude sera menée
B.4.2	Analyse de courbe longue: Complications OB & Durée des soins OB
B.4.3	Registre des Prestataires

Appendix B: Study Personnel

		Data Collection Activities																		
		Competency								Enabling Environment					Third Delay					
Name	**Professional Level**	**B.1.1**	**B.1.2**	**B.1.3**	**B.1.4**	**B.1.5**	**B.1.6**	**B.1.7**	**B.1.8**	**B.2.1**	**B.2.2**	**B.2.3**	**B.2.4**	**B.2.5**	**B.3.1.A**	**B.3.1.C**	**B.3.2**	**B.4.1**	**B.4.2**
Dr. Sourou Gbangbade*	Obstetrician/Gynecologist	X	X	X						X	X	X						X	
Dr. Noël Zonon Adannou	Pediatrician	X	X	X	X	X				X	X	X	X						
Dr. Sylvain Coudoro	Obstetrician/Gynecologist	X	X	X			X	X		X	X	X	X					X	
Dr. Christophe Houngbeme	Obstetrician/Gynecologist												X	X				X	X
Dr. Thomas Dogue	Physician/Anesthesiologist								X					X					X
Dr. Faoussath Badirou Fatoke	Pediatrician												X	X				X	
Dr. Hyacinthe Ahomlanto	Obstetrician/Gynecologist												X	X				X	
Dr. Agèle Nouratou do Rego	Obstetrician/Gynecologist																X	X	
Mme. Jeanne Houndeton	Midwife												X	X				X	
Mme. Jeanne Topanou	Midwife																X	X	
Dr. Epiphane Gainsi	Physician (retired)														X			X	

* Study coordinator and supervisor

Steven A. Harvey, MHS, of the Quality Assurance Project and Stephane Legros, MD, MPH, of the World Bank participated in field work in Benin. Bart Burkhalter, PhD, QAP Director of Operations Research, and David Nicholas MD, MPH, QAP Director, also participated in the pilot testing of instruments in Ecuador during November and December 2001. Wendy Edson, PhD, MPH, RN, contributed to the design of all study protocols and instruments prior and subsequent to pilot testing. Principal investigators were Bart Burkhalter for the Enabling Environment Study, Wendy Edson for the Third Delay Study, and Steve Harvey for the Competency Study.

Appendix C: Additional Data for Health Provider Competency Study

Table C-1. Mean skills score by type of hospital

	Mean Score Referral versus Other Hospitals		
Theme	**Referral Hospital**	**District Hospital**	**Local Hospital**
Overall skill	*60.0%	*50.2%	*46.4%
Aseptic procedure score	*60.1%	*48.6%	*50.5%
Neonatal resuscitation, ambu bag	*67.3%	58.3%	*47.6%
Neonatal resuscitation, mouth	*77.5%	*62.1%	*48.1%

* Significant at p<0.05 level

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